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# Development of Heuristics Problem Solving, and learning achievement of grade 9 students by using learning management focusing on Heuristics Approach in Thailand

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## Abstract

The objectives of this research were: 1) to develop students' Heuristics Problem Solving ability so that not less than 70% of them would have their Heuristics Problem Solving ability in "Good" level up, and 2) to develop the students' learning achievement so that the students would have average score not less than 70% up. The target group included 36 Grade 9 Students, Nongbuapittayakan School, under jurisdiction of the Office of Nongbualampoo Secondary Educational Service Area 19, the Office of Basic Educational Commission, Ministry of Education, Thailand, by using Action Research including 3 practice spirals. There were 3 kinds of instruments including: 1) the instrument using for experimentation consisted of 15 Learning Management Plans by using Learning Management focusing on Heuristics Approach, 2) the instruments using for reflection the practice performance consisted of the Finding Record Form after learning management, the Learning Management Behavioral Observation Form, the Students' Interview Form, and the Problem Solving Ability Test after learning, and 3) the instrument using for evaluating the Learning Management Efficiency consisted of the Learning Achievement Test. Data were analyzed by calculating the Mean ( $\bar{X}$ ), Standard Deviation (S.D.), Percentage, and Content Analysis. The research findings found that: 1) there were 29 students out of 36 students or 80.56%, being taught by using the Learning Management focusing on Heuristics Approach, had Heuristics Problem Solving Ability in "Good" level up which was passing specified criterion, and 2) the students being taught by using the Learning Management focusing on Heuristics Approach, had average learning achievement = 14.72 or 73.60%, and there were 26 students or 72.22% of them passing specified criterion.

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**Keywords:** Heuristics Approach, Area and Volume, Mathematics Learning Area, Thailand

## 1. Introduction

For the present world, it was rapid progressive changed, human' social and economic situations were larger as well as more progressive technology changes leading to new patterns of problems which were more complex than former

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time. In addition, the collected knowledge from the past could no longer serve to the needs for solving the problems. Consequently, every country accepted that it was necessary to have population with Mathematical Skill in order to manage new problems which were more complex. Furthermore, there were much more numbers of problems according to rapid social change. Serge, Jean-Francois, and Sylvie, M. (2004) conducted research titled “Literacy scores, human capital and growth across fourteen OECD countries indicated that the increase of average value in Literacy scores as well as the number of labor force, and the decrease of unskilled labor force, would cause GDP to be increased obviously.

According to significance of Mathematics as the above, Ministry of Education provided the students opportunity to learn Mathematics continuously. Since recent curriculum provided for the students as the Core Curriculum of Basic Education 2008 so that the students would have knowledge and comprehension in Basic Mathematics, necessary Mathematical Process Skill, and Systematic Working Ability as well as the awareness of value, and good attitude towards Mathematics (Ministry of Education, 2008). In addition, the O-net of the National Institute of Educational Testing Service (NIETS), Mathematics Learning Area, 2010 school year, found that the National average value was only 14.99% which was the lowest compared with the other Learning Areas. (The National Institute of Educational Testing Service, 2010)

Heuristics Approach was the human’s problem solving model occurred by trying to sample the problem solving techniques based on associating the prior knowledge in sampling in order to obtain the new outcomes or approaches. The researcher used Heuristics Approach developed by Krulik & Rudnick (1995) consisted of 5 problem solving steps as: 1) Read and Think, 2) Explore and Plan, 3) Select a Strategy, 4) Find an Answer, and 5) Reflect and Extend. Each step couldn’t completely separated. Moreover, the Heuristics Approach was not widely used in Thailand whereas there was widely known in other countries such as Singapore. Therefore, the researcher was interested in applying the Heuristics Learning Management Model to develop students’ Heuristics Problem Solving ability and students’ learning achievement in Mathematical Learning Area.

According to the above reasons, the researcher was interested in developing Grade 9 Students’ Heuristics Problem Solving Ability titled “Area and Volume,” and expected that the research findings would be useful for those who were interested in, and guidelines for Educational Management further.

## 2. Research Objectives

2.1 To develop Grade 9 Students’ Heuristics Problem Solving Ability, Mathematics Learning Area in “Area and Volume,” by using Learning Management focusing on Heuristics Approach so that the students would obtain average score not less than 70%, and more than 70% of students obtaining ability in Heuristics Problem solving in “Good,” level up.

2.2 To develop Grade 9 Students’ learning achievement in Mathematics Learning Area in “Area and Volume,” by using Learning Management focusing on Heuristics Approach so that the students would obtain average score not less than 70%, and more than 70% of students passing criterion.

## 3. Operational Definition

**3.1 Learning Management by using Heuristics Approach** referred to the instructional activity management focusing on the students to use Heuristics Approach. The researcher applied Krulik & Rudnick (1995) approach in conducting this study including 5 steps of Learning Management focusing on Heuristics Approach as: 1) Read and Think, 2) Explore and Plan, 3) Select a Strategy, 4) Find an Answer, and 5) Reflect and Extend.

**3.2 Heuristics Approach** was the model of human’s problem solving occurred by sampling the problem solving techniques according to the association of prior knowledge in sampling for obtaining new outcomes or approaches.

**3.3 Heuristics Problem Solving Ability** referred to the process in systematic thinking for solving the problem measured by reference the Problem Solving Model from Kulik & Rudnick (1995) including 5 steps of teaching by focusing on Heuristics Approach as: 1) Read and Think, 2) Explore and Plan, 3) Select a Strategy, 4) Find an Answer, and 5) Reflect and Extend which was measured by the Heuristics Approach Ability Test.

**3.4 Heuristics Problem Solving Ability Test** referred to the measurement instrument constructed by the researcher to measure Problem Solving Ability based on steps of Heuristics Approach Model from Kulik & Rudnick' (1995) including 5 steps of teaching by focusing on Heuristics Approach as: 1) Read and Think, 2) Explore and Plan, 3) Select a Strategy, 4) Find an Answer, and 5) Reflect and Extend by using criterion of evaluation for 5 levels including: Very Good, Good, Moderate, Fair, and to be Improved.

**3.5 Learning Achievement in Mathematics Learning Area** referred to the students' learning ability in Mathematics Learning Area which was measured by the Mathematics Learning Achievement Test titled "Surface Area, and Volume Area," in Mathematics Learning Area, Grade 9, constructed by the researcher.

## **4. Research Methodology**

### **4.1 Target Group**

Target group consisted of 36 Grade 9 Students, Nogbuawittayakan School, Muang District, Nongbualampoo Province, Thailand, under jurisdiction of the Office of Secondary Educational Service Area 19, during the first semester of 2012 school year.

### **4.2 Research Design**

Research design was an Action Research studying Kemmis and McTaggart' Action Research Spiral (1982 cited in Pongboriboon, 1994), through 4 action cycles including total of 3 action spirals.

### **4.3 Variables using in this study**

4.3.1 Independent Variable consisted of the Learning Management focusing on Heuristics Approach.

4.3.2 Dependent Variable consisted of the students' learning achievement, and Mathematical Problem Solving.

### **4.4 Instruments using in this study**

4.4.1 **The instrument using for experimentation of action** consisted of the Learning Activity Management Plans focusing on Heuristics Approach titled "Area and Volume," 15 plans, spending 15 hours.

4.4.2 **The instrument using for experimentation of action** consisted of the Students' Learning Behavioral Observation Form, the Teachers' Learning Activity Management Observation Form, the Researcher's Record Form after learning, the Students' Group Activity Evaluation Form, and the Heuristics Approach Ability Test in all of 3 spirals.

4.4.3 **The instrument using for evaluating the Learning Activity Management** consisted of the Learning Achievement Test titled "Area, and Volume," as 4 alternatives, 20 items, total of 20 points.

### **4.5 Data Collection**

4.5.1 Orientation and comprehension with students regarding to the content to be taught were provided in order to adjust their basis as well as readiness in obtaining new knowledge from Learning Management Plan constructed by the researcher for developing knowledge, comprehension, and familiarity in teaching.

4.5.2 Learning Activity Management was implemented with target group according to Learning Management Plans titled "Area and Volume," constructed by the researcher, 15 plans, 15 hours. Data from action in each cycle were collected.

4.5.3 After finishing the Learning Activity Management in every plan of Learning Management, the researcher administered the Learning Achievement Test as well as the Mathematical Problem Solving Ability of students.

### **4.6 Data Analysis**

#### **4.6.1 Quantitative Data**

4.6.1.1 The Heuristics Problem Solving Ability, the Mean ( $\bar{x}$ ), Standard Deviation (S.D.), and Percentage were calculated.

4.6.1.2 The findings of Learning Achievement Test, the Mean ( $\bar{x}$ ), Standard Deviation (S.D.), and Percentage were calculated and compared with specified criterion so that the Mean value wouldn't be less than 70%, and there were 70% of students passing the specified criterion.

#### 4.6.2 Qualitative Data

Qualitative data consisted of the information from Record Form of Learning Activity Management Behavioral Observation, the findings from activity participation, and Skill Exercise. The reflections from action were analyzed and explained with research participants. The research findings were concluded in descriptive form for evaluating the occurred situation that in what extent the implemented things were appropriate, what were problems or obstacles in order to correct and improve for obtaining efficient guidelines or model of action.

### 5. Conclusion and Discussions

**5.1 The findings of development in Mathematical Problem Solving Ability by using the Heuristics Approach,** according to the evaluation of Heuristics Problem Solving Ability of students obtaining the Learning Management focusing on Heuristics Approach considering in spiral 3, found that 29 out of 36 students, or 80.56% of them, had Heuristics Approach Ability in "Good," level up passing the specified criterion. It was because of the learning activity focusing on Heuristics Approach, the students were energetic and creative in searching for model in each spiral continuously. Although many students couldn't recite the multiplication formula, the use of problem including simple numbers for emphasizing the students to be interested in finding the model of content in Area, and Volume rather than the process for solving the equation as another content. As a result, many groups of students were able to find solution at the end. But, the Heuristics Approach had no guarantee that they would find the answer every time. Consequently, some groups of students had to face with inevitable problem as they were discourage in trying to think about different models or formulas. Furthermore, sometimes the low achiever students were absentees. So, they didn't have continuity in learning. Although the researcher was responsible for extending the learning management boundary for students, the students' Zone of Proximal wasn't accessed. In the meanwhile, the high achiever students felt that they were happy as well as cheerful with instructional management. They clapped their hands, making loud noise, and were self-confident every time. They viewed that the problem situations were challenge, and problem solving should be praised. Therefore, the outcomes included: there was occurrence that the high achiever students were separated from low achiever students obviously while the researcher viewed that the Heuristics Learning Management would cause competition which would be useful for high achiever students, but bad impact on low achiever students. So, it was necessary to consider the students carefully before using the Heuristics Approach. There should not be very different students in class. In grouping, various students should be in group including: high achiever, moderate achiever, and low achiever students. However, it couldn't be refused that the Grade 9 Students were close with their friends in the same group very much. So, the problem solving as well as unity in group couldn't be occurred. It was supported by the findings of Sasit (2002) found that the students being taught by focusing on Heuristics Reasoning, had reasoning ability passing criterion 50%. It was also supported by Barak (2011) found that the students experiencing Heuristics Learning Management not only could increase the number of solutions but also suggest additional questions. It could be concluded that the instructional management could enhance the students to understand how to solve the problem better than to complete the answer only.

**5.2 The findings of development in students' learning achievement,** according to the Learning Achievement Test after implementation in all of 3 spirals, found that the average value of learning achievement was 14.72, or 73.60%, the Standard Deviation was 2.99. There were 26 students passing specified criterion that not less than 70% of students would have learning achievement from 70% up, as the objective. It might be due to the instructional activity management was emphasized on Heuristics Approach. As a result, the students could construct knowledge by themselves, and were proud of the model constructed by them. They had impression when they were given positive reinforcement. Consequently, they were interested in, wanted to know, and had incentive to face the problem situation. It was supported by Naksombat (2007) research findings in instructional activity management by using Heuristics Approach that the students had their learning achievement 82.14% which passed the specified

criterion. It was supported by the findings of Sarasit (2002) found that the students being taught by focusing on Heuristics Approach, had higher level of learning achievement than those being taught by general teaching at 0.05 significant level. They improved their Mathematical Problem Solving Ability, better attitude, and they were developed their reasoning in association of information, analytical technique which would lead to goal, and consideration in obtained conclusions. Besides, it was supported by the findings of Rayakaew (1996) found that the students being taught by focusing on Heuristics Approach, had higher level of learning achievement as well as retention in learning than those being taught by general teaching

## 6. Recommendations

### 6.1 Recommendations from Research

6.1.1 The students should be allowed to construct body of knowledge by themselves through the Open Approach. Although they might do something wrong, being blamed or punished might cause their creativity to be decreased. They might not dare to express their opinion.

6.1.2 The Learning Management Model focusing on Heuristics Approach wasn't appropriate to be used in situation that most of students didn't have sufficient Mathematical Knowledge.

6.1.3 The selection of content to be taught, the Mathematics Content in the lessons focusing on searching for model or formula should be selected, for instance, the area finding, the volume finding, the Arithmetic Series, Probability, Set, Reasoning etc.

6.1.4 The Heuristics Approach should be inculcated in students since the recent instructional management caused by searching for the occurred model, and transferred. For Heuristics Approach, it would cause the students to be able to create new body of knowledge by themselves without waiting for being given knowledge. It would lead to attitude towards problem solving in future.

### 6.2 Recommendations for Future Research

The research in "Application of Learning Management focusing on Heuristics Approach," should be performed in the gifted students in order to see whether the special phenomenon would be occurred with those students.

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